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(54) PRODUCTION OF CONTACT LENS AND MOLD THEREFOR

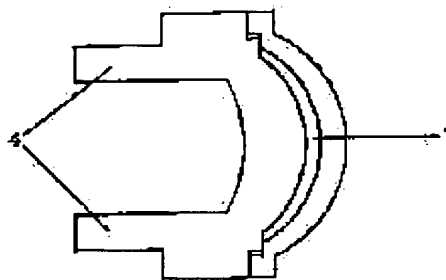
(57)Abstract:

PURPOSE: To obtain a low-cost contact lens having a smooth edge shape and surface and corresponding to a lens specification of a different shape by a method wherein a male mold is made of a resin having a low molding shrinkage, a female mold is made of a transparent resin, a monomer is charged between the molds, and after the monomer is photopolymerized, the female mold side of the molded piece is cut.

CONSTITUTION: As a male mold having a BC surface, a resin having a low molding shrinkage in volume and realizing a sufficient profile irregularity is used: for

example, polyamide, ethylene-polyvinyl alcohol copolymer, polyacetal, or amorphous polyolefin. An attachment 4 to be mounted on a lens cutting lathe is

provided. As a female mold having an FC surface, a resin having a sufficient transparency is used: for example, polyolefin, polycarbonate, styrene, or acrylic resin. A polymerizable monomer is charged into a cavity 7. After the monomer is photopolymerized by being irradiated with a light from the female mold side, the molded piece fitted with the molds intact or removed from the female mold is mounted on the lens cutting lathe and cut on its FC side.



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CLAIMS

[Claim(s)]

[Claim 1] The male which consists of the small resin of die shrinkage, and the female mold which consists of transparent resin are made to agree. After carrying out a polymerization by filling up with a polymerization nature monomer the space formed between the male and female mold, and irradiating a beam of light from a female mold side at this, it is in a condition [that both molds have agreed] -- it is -- the manufacture approach of the contact lens characterized by attaching a male in the engine lathe for lens cutting where a female mold is removed, and carrying out cutting of the front curve side of a lens.

[Claim 2] The manufacture approach of the contact lens according to claim 1 characterized by the quality of the material used for a male consisting of a polyamide, an ethylene-polyvinyl alcohol copolymer, polyacetal, and the resin chosen from amorphous polyolefine.

[Claim 3] The manufacture approach of the contact lens according to claim 1 characterized by the quality of the material used for a female mold consisting of the resin chosen from polyolefines, such as polyethylene and polypropylene, a polycarbonate, polystyrene, and acrylic resin.

[Claim 4] The die used for manufacture of the contact lens characterized by combining the female mold which consists of the resin which has transparency possible the male which consists of the small resin of die shrinkage, and cutting and sufficient to penetrate a beam of light.

[Claim 5] The die used for manufacture of the contact lens according to claim 4 characterized by the lens having pasted the male side in case the quality of the material of a male chooses so that adhesion with a contact lens ingredient may become large, and it removes a female mold from a male compared with the quality of the material of a female mold.

[Claim 6] The die used for manufacture of the contact lens according to claim 4 or 5 characterized by the quality of the material used for a male consisting of a polyamide, an ethylene-polyvinyl alcohol copolymer, polyacetal, and the resin chosen from amorphous polyolefine.

[Claim 7] The die used for manufacture of the contact lens according to claim 4 or 5 characterized by the quality of the material used for a female mold consisting of the resin chosen from polyolefines, such as polyethylene and polypropylene, a polycarbonate, polystyrene, and acrylic resin.

[Claim 8] The die used for manufacture of the contact lens according to claim 4 characterized by the lens having pasted the male side in case surface treatment is performed to either a male or a female mold, the front face of a male chooses so that adhesion with a contact lens ingredient may become large compared with the front face of a female mold, and a female mold is removed from a male.

[Claim 9] The die used for manufacture of the contact lens according to claim 8 characterized by performing surface treatment by plasma treatment.

[Claim 10] The die used for manufacture of the contact lens according to claim 8 characterized by performing surface treatment by fluorine system resin coating.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is excellent in the optical character, and relates to the die used for the manufacture approach of a quality contact lens and it which have the smooth edge configuration to which damage is not done to a cornea, and a front face. Furthermore, it is related with the manufacture approach of the low cost contact lens which can respond to the lens specification of the many forms with which configurations differed.

[0002]

[Description of the Prior Art] A contact lens can roughly be divided and can be classified into two kinds, a hard lens and a soft contact lens. Furthermore, a soft contact lens can be classified into the water soft contact lens used in the condition of having swollen with water, and the non-water soft contact lens which does not contain water. These contact lenses have merits and demerits in each, and the contact lens wearing person is choosing and using the lens which fitted itself out of these.

[0003] On the other hand, the manufacture approach of a contact lens is roughly divided and is manufactured by one approach of those with three kind, the ball-race cutting method (the cutting grinding method), the mold method, and the spin cast method (centrifugal casting method). The ball-race cutting method is an approach most generally used to manufacture of a current contact lens, and is cylindrical or a method of cutting down a carbon button-like contact lens ingredient with an engine lathe, performing cutting and polish, and manufacturing a contact lens. Although the edge section which this approach is an approach suitable for manufacturing the contact lens of the many forms with which configurations, such as BC (base curve: the field where a contact lens touches a cornea, or curvature of that field), differed, and is the important element which determines the feeling of wearing of a lens can be processed easily, there is a problem that cost is very high. It is manufactured by this ball-race cutting method, and, as for most of current and hard lenses, many manufacturers are also manufacturing the soft contact lens using the ball-race cutting method.

[0004] On the other hand, the mold method and the spin cast method are approaches by which most is used for manufacture of a soft contact lens. The mold method is an approach of filling up with a polymerization nature monomer the die which has the space of a lens configuration, carrying out the polymerization of this, and manufacturing a contact lens. Although it is possible to manufacture a quality contact lens by low cost comparatively if dimensional accuracy and profile irregularity are greatly influenced by the precision of a mold and this approach uses an accurate mold, it is difficult to manufacture the contact lens of the many forms with which configurations differed. The spin cast method is an approach of manufacturing a contact lens using slushing into the mold turning around a polymerization nature monomer, and a raw material spreading thinly with a centrifugal force. This approach also has the advantage that a contact lens can be manufactured by low cost like the mold method. However, the spin cast method will need to control many factors, such as viscosity of a polymerization nature monomer, surface tension, an amount, and a rotational frequency, and an applicable lens ingredient will also be limited to a specific thing. Moreover, the contact lens obtained by

this approach is the aspheric surface, and sufficient optical-character ability is not only obtained, but it has the description that processing of the edge section is difficult.

[0005] In recent years, the soft contact lens is widely used for people who were not able to wear the conventional hard lens from the goodness of the feeling of wearing. Therefore, the technique of manufacturing a quality soft contact lens by low cost has been variously performed by the hand of the past researchers or engineers. As a description of a soft contact lens, the lens itself is flexible, and since it is equipped in accordance with a cornea configuration, the class of very much BC is not needed like a hard lens. Therefore, in order to manufacture a contact lens with little dispersion in quality by low cost, it is thought that the mold method is suitable. Moreover, like a non-water soft contact lens like silicone rubber or long-chain alkyl methacrylate, by the ball-race cutting method, since an ingredient flexible at the time of lens processing is not processible, generally it is manufactured by the mold method.

Although the technique of manufacturing a contact lens by the mold method is well-known, very many techniques are developed about the device and amelioration for not needing post processing after manufacturing a contact lens by the mold method, and it is already indicated by the patent etc. in order to improve the optical-character ability and the feeling of wearing of a contact lens which are obtained.

[0006] for example, as a technique of filling up with a contact lens ingredient the space formed when a male and a female mold are agreed, and obtaining a contact lens To JP,63-36484,B, the weld flash which is easy to generate in the case of the contact lens manufacture by the mold method is prevented. The approach for not needing post processing prevents generating of weld flash by attaching the space for the amount accommodation of lens ingredients to JP,61-290012,A so that it may be connected with the lens formation space of mold. The approach for not needing post processing puts in in a pressure machine, after agreeing a male and a female mold in JP,2-172712,A, and it prevents generating of the weld flash of the lens periphery section by pressurizing this, and the approach for not needing post processing is indicated.

[0007] Moreover, a spacer is inserted between a male and a female mold and the approach which formed the annular spacer in order to form the space corresponding to a desired lens gestalt in JP,55-26446,B as a technique of filling up with a contact lens ingredient the space formed when it is agreed, and obtaining a contact lens is similarly indicated by JP,62-297119,A, JP,62-297120,A, etc. as an approach using a spacer.

[0008] Furthermore, the approach which combined the mold method for the ability to manufacture a contact lens with little dispersion in quality by low cost and the ball-race cutting method for the ability to manufacture flexibly the contact lens of the many forms with which configurations differed is also proposed. For example, it is indicated by JP,63-3910,A, JP,1-92719,A, etc. as an approach by which the approach of machining the convex of a lens material together with a mold in the condition [that a contact lens material is inserted into both molds for the approach of machining the periphery of a lens material together with both molds in the condition / that a contact lens material is sandwiched by both molds by the male and the female mold at JP,59-95118,A / at JP,3-76213,B] used the mold method and machining together similarly.

[0009]

[Problem(s) to be Solved by the Invention] The greatest advantage which manufactures a contact lens by the mold method can manufacture the contact lens of the same specification in large quantities, and I hear that low cost production is possible for it, and there is.

[0010] Since troublesome cares, such as washing of a soft contact lens and sterilization-by-boiling processing, are not needed but it says in recent years that it is sanitary, a disposable soft contact lens is beginning to spread quickly mainly by the United States. Although it is necessary to reduce the conventional manufacturing cost sharply in order to manufacture this disposable soft contact lens, quality cannot be reduced if a contact lens is the medical device referring to a direct cornea at all.

[0011] The manufacture approach of a contact lens JP,55-26446,B, JP,62-297119,A, and given in JP,62-297120,A is an approach of filling up with a contact lens ingredient the space formed when a spacer is inserted between a male and a female mold and it is agreed, and obtaining a contact lens, as the manufacture approach of low cost applicable also to these disposable contact lenses, and a high quality

contact lens. Although this has a smooth edge section configuration, and it is a device for preventing the weld flash produced in the periphery section of a lens in order to abolish the need for secondary elaboration and, the edge section configuration of the contact lens which the class of mold increases and it not only leads to the rise of cost, but is obtained by this approach cannot be said as that from which satisfaction is obtained enough [clinical].

[0012] Moreover, when manufacturing a contact lens by the mold method, the profile irregularity of a contact lens and configuration precision are greatly influenced by the precision of a mold, and although optical-character ability is mentioned to one of the important quality required of a contact lens, if an accurate mold is used, a quality contact lens will be obtained. However, in order to carry out a polymerization in the space formed between them as a description of the mold method combining a male and a female mold, when few inclinations arise in a mold, it will affect direct optical-character ability. That is, when the dimension of a mold has shifted slightly, or agrees a male and a female mold and both molds do not touch completely, a partial difference arises in the thickness (thickness of a contact lens) of the space formed between them combining a male and a female mold, the focus of the contact lens with which this is obtained owing to will shift from on an optical axis, serves as a form of the prism of a lens, and effect arises. This phenomenon is called the eccentricity of a lens. When a contact lens with eccentricity is worn, it is going to correct gap of this optical axis and an accommodation function will work, it will become symptoms, such as a headache, and human being's eye will appear, if the contact lens which has this eccentricity for a long time is worn. A spacer is inserted between an above-mentioned male and a female mold, and the phenomenon of this eccentricity becomes easy to happen especially by the method of filling up with a contact lens ingredient the space formed when it is agreed, and obtaining a contact lens. It is because consideration sufficient by one component called a spacer being added a male and not only a female mold but in case it needs to be processed into high degree of accuracy to a spacer and makes a spacer and a female mold a male and a spacer agree further again for that contact condition must be performed and the phenomenon of this eccentricity surely becomes easy to happen by the assembly line-approach by people's hand and machine which are the conventional approach.

[0013] Moreover, although the device is added to the configuration of the edge section of a lens in order for the die for contact lens manufacture given in JP,63-36484,B to consist of two components, a male and a female mold, and to prevent generating of weld flash, the edge section configuration of the contact lens obtained by this approach cannot be said as that from which satisfaction is obtained enough [clinical]. Moreover, in this die, there is a fault of the contact surface of a male and a female mold being very narrow, and it being comparatively difficult to take out the precision of the thickness of a lens, and being easy to generate above-mentioned eccentricity. An edge section configuration cannot be said as that from which satisfaction is obtained enough [clinical] by the approach JP,61-290012,A and given in JP,2-172712,A, but it can be said that it is very difficult to make this eccentricity there be nothing further.

[0014] Although each technique which fabricates the soft contact lens of one shot by the mold method so far has been described focusing on the trouble, the big problem of the mold method is that a limitation is in the quality of that the contact lens of the many forms with which configurations differed cannot be manufactured flexibly, and an edge section configuration as a whole. The approach which combined the mold method for the ability to manufacture a contact lens with little dispersion in quality by low cost as an effective means to solve this trouble, and the ball-race cutting method for the ability to manufacture flexibly the contact lens of the many forms with which configurations differed is proposed.

[0015] Although the manufacture approach of a contact lens given in JP,59-95118,A is in a condition [that a contact lens material is sandwiched by both molds by the male and the female mold] and it is the approach of machining the periphery of a lens material together with both molds, since BC and FC (front curve: the field of the opposite side of the field where a contact lens contacts a cornea, or curvature of that field) are decided by the configuration of a mold, by this approach, the contact lens of the many forms with which configurations differed cannot be manufactured flexibly. Although the manufacture approach of a contact lens given in JP,3-76213,B is the approach of machining the convex

of a lens material together with a mold in the condition [that a contact lens material is inserted into both molds], it has the fault that profile irregularity, especially the profile irregularity of BC are inadequate. This originates in the ingredient of the mold currently used from the former in many cases. Similarly sufficient profile irregularity is not acquired by the manufacture approach of a contact lens given in JP,63-3910,A.

[0016] As mentioned above, although the advantage and the trouble in the case of manufacturing a contact lens using the trouble by the manufacture approach of the present contact lens and the approach which combined the mold method or the mold method, and the ball race cutting method further have describe, this invention is excellent in the optical character, has the smooth edge configuration and the smooth front face which do not do damage to a cornea, and aims at manufacturing the low cost contact lens which can respond to the lens specification of the many forms with which configurations moreover differed.

[0017]

[Means for Solving the Problem] Namely, the manufacture approach of the contact lens of this invention The male which consists of the small resin of die shrinkage, and the female mold which consists of transparent resin are made to agree. After carrying out a polymerization by filling up with a polymerization nature monomer the space formed between the male and female mold, and irradiating a beam of light from a female mold side at this, it is in a condition [that both molds have agreed] -- it is - where a female mold is removed, a male is attached in the engine lathe for lens cutting, and it is characterized by carrying out cutting of the FC side of a lens.

[0018] Moreover, the die used for manufacture of the contact lens of this invention is characterized by combining the female mold which consists of the resin which has transparency possible the male which consists of the small resin of die shrinkage, and cutting and sufficient to penetrate a beam of light.

[0019] Furthermore, in case the quality of the material of a male chooses so that adhesion with a contact lens ingredient may become large, and it removes a female mold from a male compared with the quality of the material of a female mold, it is characterized by the lens having pasted the male side.

[0020] Furthermore, in case surface treatment is performed to either a male or a female mold, the front face of a male chooses so that adhesion with a contact lens ingredient may become large compared with the front face of a female mold, and a female mold is removed from a male, it is characterized by the lens having pasted the male side.

[0021] Hereafter, this invention is explained to a detail.

[0022] The sectional view of the male of the contact lens die according [drawing 1] to this invention and drawing 2 are the sectional views of a female mold, and drawing 3 is the built-up-section Fig. showing the integrated state of the contact lens die by this invention.

[0023] The male of the contact lens die of this invention consists of attachments 4 when attaching in the engine lathe for lens cutting, after carrying out a polymerization, the contact surface 2 of the male which contacts when making a mold agree, after being filled up with the convex BC optical surface 1 and polymerization nature monomer which form BC, when it fabricates in a contact lens configuration, as shown in drawing 1 , and. When it fabricates in a contact lens configuration, the convex BC optical surface 1 which forms BC is processed on the mirror plane smooth enough.

[0024] On the other hand, a female mold consists of the contact surface 3 of the mold which contacts when making a mold agree as shown in drawing 2 , after being filled up with a polymerization, the concave FC forming face 5 which forms FC of a contact lens after carrying out cutting, and a polymerization nature monomer, and the lateral portion contact surface 6 of the mold which prevents gap of the location of FC side and BC side.

[0025] If it agrees and these males and female molds are assembled, as shown in drawing 3 , the space (mold cavity) 7 which constitutes a lens configuration will be formed between FC forming face and BC optical surface. after being filled up with a polymerization nature monomer in the mold cavity and carrying out the polymerization of this, it is in a condition [that both molds have agreed] -- it is -- where a female mold is removed, a male is attached in the engine lathe for lens cutting through an attachment, cutting of the FC side of a lens is carried out, and a contact lens is obtained.

[0026] Then, the quality of the material of a die is described. It is characterized by the die of this invention using the quality of the material which is different by the male and the female mold. Usually, as for the ingredient used as a disposable mold for contact lens manufacture, polyolefines, such as polyethylene and polypropylene, are used. Although photopolymerization by mainly irradiating a beam of light is performed in case the contact lens other than the reason this has a cheap ingredient is manufactured by the mold method, it is because the mold used in this case must be what penetrates the beam of light of sufficient amount needed for a polymerization. However, as a description of these ingredients, the volumetric shrinkage at the time of shaping is large, and it is very difficult to acquire profile irregularity sufficient after shaping. Moreover, the mold-release characteristic of a mold and a contact lens ingredient is a very big problem as conditions for the die used for contact lens manufacture. Therefore, although the quality of the material of a mold usable as a contact lens die will be limited considerably, sufficient quality of the material to take out the profile irregularity of an optical surface from the inside must be chosen. Then, it is characterized by using the resin which has sufficient transparency to penetrate a beam of light required for a polymerization possible [cutting] to the female mold which has FC forming face which carries out fabricating after shaping using the resin which can take out profile irregularity small the volumetric shrinkage according to shaping irrespective of penetrating a beam of light to the male which has BC optical surface to which the die of this invention does not carry out fabricating, and bending and sufficient. Therefore, the space formed between a male and a female mold is filled up with a polymerization nature monomer, and a polymerization is completed by irradiating a beam of light from the female mold side which changes from transparent resin to this.

[0027] By manufacturing a contact lens by the above approach, it excels in the optical character and the quality contact lens which has the smooth edge configuration to which damage is not done to a cornea, and a front face can be manufactured. Moreover, it is possible to be able to respond to the lens specification of the many forms with which configurations differed, in order to carry out cutting of the FC side, and to manufacture by low cost moreover. Furthermore, the eccentricity made into a problem by manufacture of the contact lens by the mold method is also avoidable.

[0028] As the concrete quality of the material of the die used for this invention, the ingredient generally used as mold material is applicable. A die with a high precision can be manufactured by low cost by using especially thermoplastics and applying the approach usually used [compression forming / an injection-molding method, an injection-compression-molding method, or] for shaping of plastics in this. moreover, the thing carried out for this die to throwing away -- the washing process of a mold -- it can exclude -- very -- productivity -- it is possible to manufacture a contact lens highly.

[0029] As an example of the thermoplastics which can be used for the ingredient of a male, a polyamide, an ethylene-polyvinyl alcohol copolymer, polyacetal, amorphous polyolefine, etc. can be mentioned.

[0030] On the other hand, as an example of the thermoplastics which can be used for the ingredient of a female mold, polyolefines, such as polyethylene and polypropylene, a polycarbonate, polystyrene, acrylic resin, etc. can be mentioned.

[0031] And in consideration of the rate of a volumetric shrinkage at the time of shaping which is the polymerization method of a contact lens, the class of polymerization nature monomer, cost, etc. and many physical properties of plastics, light transmission, thermal resistance, solvent resistance, mechanical characteristics (viscoelasticity etc.), a moldability, etc., the die materials which were most suitable for contact lens manufacture of the purpose are chosen from these plastics.

[0032] after the manufacture approach of the contact lens of this invention fills up with a polymerization nature monomer the space formed between a male and a female mold and carries out photo-curing of this, it is in a condition [that both molds have agreed] -- it is -- where a female mold is removed, a male is attached in the engine lathe for lens cutting, and it is characterized by carrying out cutting of the FC side of a lens. When carrying out cutting in the condition [that both molds have agreed in this manufacture approach], since it is not necessary to release a female mold from mold from a male, it is not so big a problem to control the adhesion of a contact lens ingredient and a mold. It may be better to have pasted up the contact lens ingredient and the female mold firmly rather. However, when carrying

out cutting of the female mold in the condition of having removed from the male, in case a female mold is removed from a male, the contact lens ingredient always needs to paste the male side. Therefore, in case the quality of the material used for a mold is chosen, it should choose in consideration of adhesion with a contact lens.

[0033] However, only by selection of the quality of the material used for a mold, in case a female mold is removed from a male, it may be unable to control in the condition of having always pasted up the contact lens ingredient on the male side. As a means in this case, surface treatment is performed to either a male or a female mold, and there is an approach which the front face of a male processes compared with the front face of a female mold so that adhesion with a contact lens ingredient may become large. This can say the same thing, also when the die materials of the same quality of the material as a male and a female mold are used.

[0034] Plasma treatment can be mentioned as the approach of surface treatment. Although it can carry out by any approach of corona discharge and glow discharge as the approach of plasma treatment, as for the resin front face which generally performed plasma treatment, surface energy goes up compared with an unsettled front face, and the adhesion with other resin becomes large. Therefore, in this invention, in case adhesion with a contact lens ingredient is raised and a female mold is removed from a male by performing plasma treatment only to a male, the method of pasting up a contact lens ingredient on a male side is suitable.

[0035] On the other hand, fluorine system resin coating can be mentioned as the approach of another surface preparation. This approach has the advantage that it can carry out by easy actuation that what is necessary is just to apply the fluorine system resin coating agent generally marketed. Moreover, when using a die by throwing away, the endurance of a coating agent does not pose a big problem, either, but there are very many classes of usable coating agent. As for the resin front face which generally performed fluorine system resin coating, surface energy falls compared with an unsettled front face, and the adhesion with other resin becomes small. Therefore, in this invention, in case adhesion with a contact lens ingredient is reduced and a female mold is removed from a male by performing fluorine system resin coating only to a female mold, the method of pasting up a contact lens ingredient on a male side is suitable.

[0036] Then, the polymerization method of the contact lens by this invention is described. The polymerization of this invention is performed by the exposure of activity energy lines, such as ultraviolet rays, under existence of the usual polymerization initiator. It piles up so that the convex shaping side of a male may agree in initial-complement discharge in the concave shaping side of a female mold and may agree a polymerization nature monomer in this in a previous concave shaping side. Under the present circumstances, the contact surface and the lateral portion contact surface of a mold warn to contact completely. In this way, ultraviolet rays etc. are irradiated from the female mold side of the assembled mold, and it is suitable to carry out photopolymerization.

[0037] A polymerization nature monomer applicable to this invention is a compound which is generally used and in which a radical polymerization is possible, is the compound which contains a vinyl group, an allyl group, an acrylic radical, or an methacrylic radical in [one or more] a molecule, and is matter usually used as a hard lens or a soft contact lens ingredient. Specifically, vinyl compounds, such as acrylic ester (meta), such as alkyl (meta) acrylate, siloxanyl (meta) acrylate, fluoro alkyl (meta) acrylate, hydroxyalkyl (meta) acrylate, polyethylene-glycol (meta) acrylate, acrylic ester (meta) of polyhydric alcohol, and vinyl (meta) acrylate, a derivative of styrene, N-vinyl lactam, and carboxylic-acid (multiple valued) vinyl, etc. are mentioned. Still more specifically For example, styrene, an acrylic acid, methyl acrylate, Ethyl acrylate, n-butyl acrylate, phenyl acrylate, 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate, A methacrylic acid, methyl methacrylate, ethyl methacrylate, n-butyl methacrylate, 2-ethylhexyl methacrylate, isobornyl methacrylate, Benzyl methacrylate, phenyl methacrylate, 2-methacryloiloxy-ethyl succinic acid, 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, 2-hydroxy butyl methacrylate, fumaric acids and those ester, a methacrylonitrile, N,N-dimethylacrylamide, an N-vinyl-2-pyrrolidone, etc. are mentioned.

[0038] Furthermore, as a cross linking agent, ethylene GURIKORUJI (meta) acrylate, Diethylene

GURIKORUJI (meta) acrylate, TORIECHIRENGURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate, TORIMECHI roll pro pantry (meta) acrylate, Pen TAERISURITORUTORI (meta) acrylate, 1, 4-butane JIORUJI (meta) acrylate, Polyfunctional monomer, such as 1, 6-hexane JIORUJI (meta) acrylate, GURISERINJI (meta) acrylate, divinylbenzene diallyl phthalate, and diethylene-glycol bisallyl carbonate, can also be used.

[0039] It is necessary to carry out by choosing the polymerization method suitable for this, the class of polymerization initiator, an addition, etc. in consideration of the property of these polymerization nature monomers to be used, i.e., viscosity, the rate of a volumetric shrinkage, a rate of polymerization, etc.

[0040]

[Function] The die used for the manufacture approach of a contact lens and it by this invention It is characterized by using the male which consists of the small resin of die shrinkage, and the female mold which consists of transparent resin. Make this male and female mold agree and the space formed between that male and female mold is filled up with a polymerization nature monomer. After carrying out a polymerization by irradiating a beam of light from a female mold side at this, in the condition [that both molds have agreed] Or in order to attach a male in the engine lathe for lens cutting where a female mold is removed, and to carry out cutting of the FC side of a lens, It excels in the optical character, and has the smooth edge configuration and smooth front face which do not do damage to a cornea, and the low cost contact lens which can respond to the lens specification of the many forms with which configurations moreover differed can be manufactured.

[0041]

[Example] Although an example explains in more detail below, this invention is not limited to these.

[0042] (Example 1) In this example, polypropylene was used as the quality of the material of a female mold which uses a polyamide as the quality of the material of the male shown in drawing 1 , and sets the curvature of BC optical surface to 7.25mm, and is shown in drawing 2 , and the die which set the curvature of FC forming face to 7.2mm, and was manufactured with injection molding was used. As a polymerization nature monomer, the 2, 3-dihydroxy propyl methacrylate 70 weight section, methyl methacrylate 28 weight section, ethylene glycol dimethacrylate 1 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80 W/cm high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from the female mold side for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the lens semifinished product has pasted up and cutting the FC side of a lens with the curvature of 7.70mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0043] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -3.00D by 8.60mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0044] (Example 2) In this example, polypropylene was used as the quality of the material of a female mold which uses a polyamide as the quality of the material of the male shown in drawing 1 , and sets the curvature of BC optical surface to 6.90mm, and is shown in drawing 2 , and the die which set the curvature of FC forming face to 7.2mm, and was manufactured with injection molding was used. As a polymerization nature monomer, the 2, 3-dihydroxy propyl methacrylate 70 weight section, methyl methacrylate 28 weight section, ethylene glycol dimethacrylate 1 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80 W/cm high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from the female mold side for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the lens

semifinished product has pasted up and cutting the FC side of a lens with the curvature of 7.65mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0045] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -8.00D by 8.20mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0046] (Example 3) In this example, polymethylmethacrylate was used as the quality of the material of a female mold which uses an ethylene-polyvinyl alcohol copolymer as the quality of the material of the male shown in drawing 1, and sets the curvature of BC optical surface to 6.90mm, and is shown in drawing 2, and the die which set the curvature of FC forming face to 7.2mm, and was manufactured with injection molding was used. As a polymerization nature monomer, the 2, 3-dihydroxy propyl methacrylate 70 weight section, methyl methacrylate 28 weight section, ethylene glycol dimethacrylate 1 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80 W/cm high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from the female mold side for 100 seconds in the distance of 10cm. After attaching the male in the engine lathe for lens cutting in the condition [that both the molds after hardening have agreed] and cutting the FC side of a lens together with a female mold with the curvature of 7.65mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0047] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -8.00D by 8.20mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0048] (Example 4) In this example, the polycarbonate was used as the quality of the material of a female mold which uses polyacetal as the quality of the material of the male shown in drawing 1, and sets the curvature of BC optical surface to 7.21mm, and is shown in drawing 2, and the die which set the curvature of FC forming face to 7.2mm, and was manufactured with injection molding was used. As a polymerization nature monomer, the 2-hydroxyethyl methacrylate 96 weight section, ethylene glycol dimethacrylate 2 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80 W/cm high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from the female mold side for 100 seconds in the distance of 10cm. After attaching the male in the engine lathe for lens cutting in the condition [that both the molds after hardening have agreed] and cutting the FC side of a lens together with a female mold with the curvature of 7.72mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0049] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -3.00D by 8.60mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0050] (Example 5) In this example, the die which used amorphous polyolefine (ZEONEX280: Nippon Zeon Co., Ltd. make) as the quality of the material of a female mold shown in the male shown in drawing 1 and drawing 2, and set the curvature of BC optical surface of a male to 7.21mm, and set the curvature of FC forming face of a female mold to 7.2mm, and was manufactured with injection molding was used. In addition, plasma treatment was performed to the male used here. As the approach of plasma treatment, this male was installed in plasma equipment and processing for 3 minutes was performed by

the discharge frequency of 13.56MHz, and discharge power 200W among the argon ambient atmosphere of degree of vacuum 0.1Torr. As a polymerization nature monomer, the 2-hydroxyethyl methacrylate 96 weight section, ethylene glycol dimethacrylate 2 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80W [/cm] high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from both by the side of a male and a female mold for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the lens semifinished product has pasted up and cutting the FC side of a lens with the curvature of 7.72mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0051] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -3.00D by 8.60mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0052] (Example 6) In this example, the die which used amorphous polyolefine (ZEONEX280: Nippon Zeon Co., Ltd. make) as the quality of the material of a female mold shown in the male shown in drawing 1 and drawing 2 , and set the curvature of BC optical surface of a male to 7.21mm, and set the curvature of FC forming face of a female mold to 7.2mm, and was manufactured with injection molding was used. In addition, the fluorine system resin coating agent was applied to the female mold used here. As a polymerization nature monomer, the 2-hydroxyethyl methacrylate 96 weight section, ethylene glycol dimethacrylate 2 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80W [/cm] high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from both by the side of a male and a female mold for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the lens semifinished product has pasted up and cutting the FC side of a lens with the curvature of 7.72mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0053] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -3.00D by 8.60mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0054] (Example 7) In this example, poly polypropylene was used as the quality of the material of a female mold which uses amorphous polyolefine (ZEONEX280: Nippon Zeon Co., Ltd. make) as the quality of the material of the male shown in drawing 1 , and sets the curvature of BC optical surface to 7.21mm, and is shown in drawing 2 , and the die which set the curvature of FC forming face to 7.2mm, and was manufactured with injection molding was used. In addition, corona discharge treatment was performed to the male used here. As the approach of corona discharge treatment, this male was installed in inter-electrode [of corona discharge equipment with the inter-electrode distance of 2cm, an inter-electrode electrical potential difference / of 25 kilovolts /, and a frequency of 20kHz], and processing for 1 minute was performed. As a polymerization nature monomer, the 2-hydroxyethyl methacrylate 96 weight section, ethylene glycol dimethacrylate 2 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.05 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80W [/cm] high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from both by the side of a male and a female mold for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the

lens semifinished product has pasted up and cutting the FC side of a lens with the curvature of 7.72mm, the FC side front face was ground. The elution of an effluent was completed at the same time it was immersed in a physiological saline and carried out water absorption of the specified quantity, after making the obtained contact lens swell in pure water and washing it.

[0055] In this way, the obtained soft contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -3.00D by 8.60mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0056] (Example 8) Polypropylene was used as the quality of the material of a female mold which considers as the quality of the material of the male shown in drawing 1 in this example, uses a polyamide, and sets the curvature of BC optical surface to 7.80mm, and is shown in drawing 2, and the die which set the curvature of FC forming face to 7.5mm, and was manufactured with injection molding was used. As a polymerization nature monomer, the 2, 2, and 2-trifluoroethylmethacrylate 44 weight section, tris (trimethylsiloxy) silyl propyl methacrylate 40 weight section, 2-hydroxyethyl methacrylate 10 weight section, ethylene glycol dimethacrylate 3 weight section, 2 and 4, and 6-trimethyl benzoyl diphenylphosphine oxide 0.2 weight section was often mixed, and what performed degassing of this mixture and a nitrogen purge was used. The previous die was filled up with this mixture, 80 W/cm high-pressure mercury lamp was used for this, and ultraviolet rays were irradiated from the female mold side for 100 seconds in the distance of 10cm. The female mold was removed from the male after hardening, and after attaching in the engine lathe for lens cutting the male which the lens semifinished product has pasted up and cutting the FC side of a lens with the curvature of 8.10mm, the FC side front face was ground.

[0057] In this way, the obtained contact lens had the edge part and the smooth front face, and there was no opening in a contact lens front face and the interior. Moreover, BC of this soft contact lens has -2.00D by 7.80mm, and, as for power, prism was very excellent in optical-character ability, such as not being observed at all.

[0058]

[Effect of the Invention] The die used for the manufacture approach of a contact lens and it by this invention The male which consists of the small resin of die shrinkage, and the female mold which consists of transparent resin are made to agree. After carrying out a polymerization by filling up with a polymerization nature monomer the space formed between the male and female mold, and irradiating a beam of light from a female mold side at this, In the condition [that both molds have agreed], or in order to attach a male in the engine lathe for lens cutting where a female mold is removed, and to carry out cutting of the FC side of a lens, It excels in the optical character, and has the smooth edge configuration and smooth front face which do not do damage to a cornea, and the low cost contact lens which can respond to the lens specification of the many forms with which configurations moreover differed can be manufactured.

[Translation done.]